Evaluation, rehabilitation, and repair of pipelines conference

20-21 October, 2010, Berlin

Provisional programme – 20 September 2010

Wednesday, 20 October

8.30 Registration

9.00 Opening remarks

9.15 [1] Keynote address: The regulatory environment in Germany and technical innovations in gas transport: a challenge, by **Heinz Watzka**, Managing Director, Open Grid Europe GmbH, Essen, Germany

9.45 [2] Implementation of a pipeline integrity management system at a major state-run pipeline operator: a case study, by **Markus Brors**, Rosen Integrity Solutions, Lingen, Germany, and **Thomas Beuker**, Rosen Headquarters, Stans, Switzerland

> On first sight, the implementation of an IT-based Pipeline Integrity Management System is pursued to provide functionality and software tools to assess the status of a pipeline system as well as to determine and to control corrective actions and improvements required for the stable and sustainable operation of the asset.
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> Today, the scope of such management systems allows network-wide risk assessment considering a variety of possible scenarios and threats. Amongst others, these considerations are based on In-Line Inspection results to develop prioritization and repair plans. However, a successful implementation cannot be achieved by the software package only. The crucial part is a weighted strategy to assess and adapt existing operational processes. This leads typically to an overall change in the mindset towards an effective use of the Integrity Management System.
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> A case study is presented discussing the implementation process for a major state-run pipeline operator. The existing virtual and analog workflows and processes were made transparent to the responsible personnel. The flow of essential information is channeled in a timely manner to the appropriate positions within the company allowing efficient and substantiated decisions.

10.25 Coffee and exhibition

11.00 [3] Evaluation of pipeline dents using ILI data, by **Dr Ted L Anderson** and **Dr Gregory W Brown**, Quest Integrity Group, LLC, Boulder, CO, USA

> Improvements in in-line inspection (ILI) and computing technology, coupled with the emergence of fitness-for-service standards, have created an opportunity to advance the state-of-the-art in pipeline integrity evaluation. This paper describes a novel approach for assessing dents in pipelines using data from ILI tools that combines a detailed mapping of the dent from ILI data with 3-D elastic-plastic finite-element analysis. A dimensionally-accurate 3-D model of the dented pipe is subjected to cyclic loading, and remaining life is computed through a proprietary low-cycle fatigue-damage model. The process can be applied to interacting anomalies such as dent/gouge and dent/crack combinations, and application of this methodology to the evaluation of the fitness-for-service of in-service pipelines under operating conditions is presented.

11.40 [4] An overview of the challenges faced in order to clean and inspect the UK N Sea's 36-in, 412-km long CATS gas pipeline, by **Paul Clayton**, PII Pipeline Solutions, Cramlington, UK, and **Mark Kelso**, BP, Sunbury on Thames, UK

Commissioned in 1993, the 408-km long Central Area Transmission System (CATS) pipeline is a strategic lifeline for the UK's gas supply. Inspection of this pipeline was a unique project as it presented a large number of issues to overcome in order to complete a successful inspection mission. Although some of the technical challenges posed by this particular pipeline were not unusual in large-diameter offshore gas trunk lines, it was certainly demanding to have to overcome so many potential issues in a single project. The project was executed under the recent global in-line inspection agreement between PII and BP, and this paper describes the preparation, execution, and outcome for the project.

12.20 [5] How to deal with a large amount of defects after in-line inspections?, by **Thomas Salvan**, TRAPIL, Paris, France

Most European pipelines are ageing and the use of intelligence pigging has been growing years after years as shown in the last report on Performance of European Cross-country Pipelines published by CONCAWE. On the other hand, as the technology improves continuously, in-line inspection tools record more and more defects. The financial and human resources for investigating and repairing the defects are limited. So, after in-line inspections gathering a large amount of defects, most pipeline operators have first to prioritize the investigations using a risk-based analysis, the adopt temporary mitigation procedures, and finally, after investigation and if a repair is needed, adopt the most efficient methods from both technical and financial viewpoints.

TRAPIL is a major multi-products pipeline operator in Europe and has a continuing commitment to environmental protection and safe transportation of petroleum products. Its pipelines are inspected regularly every five years. This paper describes the methodology adopted to prioritize the investigations and the methods which are used for repairs.

13.00 Lunch and exhibition

14.00 [6] Re-use of a mature pipeline based on the fitness-for-service assessment concept, by **Afshin Motarjemi**, **Robert Condor**, and **Matt Ki**rk, Xodus Group Ltd, London, UK

According to research conducted by the UK Health and Safety Executive, thereare an exceptionally-large number of mature assets in the UK Continental Shelf being operated beyond their original design life of 30 years. These assets clearly need to be evaluated in terms of safe continued operation. This includes mature pipelines, where operators would like to re-use them beyond the design life and often at slightly higher pressure and temperature, if proven to be technically feasible and safe. The fitness-for-service (FFS) concept can be tailor-made to assist operators in such a decision-making process. In this paper, this concept has been applied to a mature corroded pipeline: initially, the feasibility of the pipeline's re-use was assessed; subsequently, a time-dependent FFS assessment procedure based on a damage-growth model was used to extrapolate performance of the pipeline into the future (beyond its original design life), and also to establish future inspection intervals.

15.20Coffee and exhibition

15.45 [7] Fitness-for-purpose study for a large-diameter sour crude pipeline based on in-line inspection results, by **C. Jäger**, **A. Pfanger**, and **M. Frank**, NDT Systems & Services AG, Stutensee, Germany

The use of in-line inspection tools is nowadays a standard routine for investigating the integrity of a given pipeline. Advanced inspection tools record geometric data on the anomalies or flaws present in the pipe wall, and these data can subsequently be used to investigate the integrity of the inspected pipeline and perform a fitness-for-purpose investigation.

This paper reports on a fitness-for-purpose investigation carried out on a 36-indiameter sour crude pipeline. The inspection revealed the presence of dents, laminations, and internal channelling corrosion, as well as blistering, the latter atypical feature found in the presence of a sour medium. Based on the data collected by the inspection tool, a detailed fitness-for-purpose study was initiated in order to assess the severity of the anomalies detected. After selection of the most appropriate assessment method for the various anomaly types, the anomalies were assessed focusing on their immediate effect on the integrity of the pipeline. Due to the aggressive corrosion behaviour of the sour crude in major sections of the pipeline, a rehabilitation strategy, including a cost-efficient repair and re-inspection plan, was developed.

15.45 [8] Inspection of gas pipelines with ultrasonic measurement techniques: practical aspects, by **Jochen Stratmann**, E.ON Ruhrgas AG, Essen, Germany

Pipeline-inspection tools based on ultrasonic measuring techniques are frequently used for the assessment of oil pipeline integrity. Due to the requirement of a liquid being present between the detection device and the pipe wall, this technique is not readily applicable to gas pipelines. Recently, the inspection of gas pipelines with ultrasonic devices has been conducted successfully by completely filling the pipeline with liquid (such as water) before the inspection. As an alternative, a short section ('batch') of liquid may be run through the pipe in order to avoid the complete fill. Pigs separate the liquid from the surrounding gas in the pipeline, and the measurement device is kept within the liquid-filled section. Batches may, however, assume considerable velocities where there are large slopes along the path of the pipeline, and this may influence the probability of detection, and, more practically, it constitutes a risk of pipeline damage if velocities become too high. The focus of this paper is a method of calculating the batch velocity, and predicting water batch movements in pipes, as well as other practical aspects.

16.25 [9] Pipeline repair using full-encirclement steel sleeves, by **William A. Bruce**, DNV Columbus, Inc., Dublin, Ohm, USA

To prevent an area of corrosion damage from causing a pipeline to rupture, the area containing the damage must be reinforced to prevent the pipeline from bulging. While the use of non-metallic composite materials to repair corrosion damage has increased in recent years, the most predominant method of reinforcing corrosion damage in cross-country pipelines is to install a full-encirclement steel sleeve. The basic principals of pipeline repair using steel sleeves, along with some advantages over the use of composite materials, will be presented.

17.05 Reception in exhibition
19.00 End of day

Thursday 21 October

08.30 [10] GRT gaz' strategy for asset management, by **Patrick Pelle**, **Samir Akel**, and **Mylène Poitou**, GRT gaz, Val de Seine District, France

GRT gaz owns and operates the longest high-pressure gas-transmission network in Europe, comprising 32,000km of steel pipelines. The company ensures the continuous balance between the imperatives of industrial safety and financial issues related to pipeline maintenance and renewal. It has recently developed a policy proposing

operational methods of carrying out objective economic andtechnical analyses, allowing prioritization of maintenance work according to the corrosiveness of the soil, as well as to inform decisions regarding the rehabilitation or replacement of both piggable and non-piggable pipelines. The policy is based on estimation of the probability of failure of a homogeneous section of the pipeline using a probabilistic tool developed by the Research and Innovation Division of GDF SUEZ, based on the results of the inspection of the pipe.

This approach has been applied to a pipeline of approximately 100km, around Paris. The first results allowed ranking of the different sections according to their criticality. Additional studies are required on about 8km to confirm the level of criticality of these sections, and to inform the decision regarding rehabilitation ofthe pipeline as well as to define an optimal repair plan from a technical and economic point of view that is also compliant with industrial safety requirements.

09.10 [11] Cost-effective pipeline rehabilitation, by **Angus Patterson** and **Steve Cromwell**, MACAW Engineering Ltd, Newcastle upon Tyne, UK

With the demand for energy from an ageing pipeline infrastructure, there is an increasing need to ensure the integrity of assets and extend their safe remaining life. Inline intelligent tools give an accurate snapshot of the current condition of pipelines. However, getting the most out of the in-line inspection data in combination with any other historical/current inspection maintenance or operational data is critical to ensuring the long life of pipelines. This paper uses real case studies and experiences to review the key stages of a pipeline integrity assessment in determining an economical pipeline rehabilitation strategy.

09.50 [12] Rehabilitation of a pipeline in a new European country, by **Abraham Louwerse**, ILF Consulting Engineers, Munich, Germany

Many pipelines constructed in the last two decades are up to modern standards; however, older ones are very difficult to operate and are not easy to assess for certification and maintaining the permit to operate. Many of these older pipelines are not piggable and have no routine maintenance or integrity testing, and the documentation over the lifecycle is mostly out of date or incomplete; thus the difficulty in determining the integrity status of these pipelines.

This paper presents the way ILF investigated the integrity of a pipeline in a new Eastern European country, the difficulties encountered, and how plans were created to determine the integrity of this pipeline and the programme for its rehabilitation.

10.20 [13] Technical and economic aspects of the redesign of corrosion protection systems as part of a pipeline rehabilitation programme, by **Torsten Krebs**, German Cathodic Protection GmbH, Essen, Germany

11.00 Coffee and exhibition

11.30 [14] Using rate of flow to control application of coatings during field recoating, by **Sidney Taylor**, Incal Pipeline Rehabilitation Inc, Paris, France

Automated coating applicators greatly improve the uniformity and consistency of field application of coatings. This accuracy can be improved further by monitoring the flow rate of the coating material and using this data to control the operation of the applicator. This paper derives the formulas necessary to convert flow rate into application rate. Data collection problems are discussed as well as appropriate data averaging techniques to provide accurate results. The flow rate scan be used to prevent mis-metering problems. The paper also discusses how the recorded data can be used to refine and target coating inspection and the impact this data can have on preventive maintenance programmes for the proportioning equipment.

12.10 [15] Rehabilitation of corrosion protective coatings on buried steel pipelines, by **Michael Schad** and **Thomas Rehberg**, Denso GmbH, Leverkusen, Germany

> After construction of large oil and gas pipeline networks in the last 50 years, rehabilitation of these pipelines, and particularly of their corrosion-protective coatings, has now become a topical problem. Materials to be refurbished are bituminous and coal-tar coatings, as well as PVC-and PE-based first-generation two-ply tapes. The reasons for the failure of these systems are both material properties and intrinsic drawbacks, as well as faults during application. State-of-the-art cold-applied three-ply tapes based on polyethylene and butyl rubber afford perfect sealing of the surface to be protected combined with maximum ageing resistance.
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> This paper goes on to review other coating options for pipeline rehabilitation as well as the techniques for their application.

12.50 Lunch

13.45 [16] The use of visco-elastic self-healing pipeline coating, by **Dr J F Doddema**, Stopaq B.V., Stadskanaal, Netherlands

> Modern pipeline maintenance requires advanced corrosion-prevention systems in order to prolong service cycles and to ensure reliable and sustainable operation. Corrosion is one of these issues that will affect the safe and efficient running of a pipeline, with the costs for shutdown, production loss, environment contamination, and loss of customer confidence being considerable.
> The latest amorphous viscous-elastic polymer pipeline coating technology has no specific chemical functionality and exhibits new aspects for sustainable corrosion protection. The new coating system offers an extremely low-cost and innovative approach for rehabilitation and coating of field joints. This technology has been developed for use as an external coating of pipelines, and has been designed and tested specifically to fit the special field application requirements of buried oil and gas pipelines, exhibiting properties that are contrary to traditionally specified systems and in most cases far exceeding them. In this paper, the properties and the tape-like application of the elastomer will be described, and the possibilities for using the elastomers as part of a pipeline-maintenance programme will be discussed.

14.25 [17] Exchange of 32 pipes on the 20-in diameter Druzhba crude oil pipeline in 96 hours, by **Ing. Aleš Brynych** and **Dr Ing. Petr Crha**, CEPS a.s., Jesenice u Prahy, Czech Republic

> Special repair activities were carried out on the Druzhba crude oil pipeline between the pumping station at Klobouky and the village of Těšany in southern Moravia in the Czech Republic in September 2007. These activities were unique, limited in the time available and in the number of workers and equipment used.32 off–size pipes were replaced with new ones in a 9.7-km long section of the pipeline in 96 hours.
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> At the start of the project the pipeline section was full of crude oil (approximately2000 m^3) under hydrostatic pressure. To be able to complete the project, CEP Shad to choose a unique and unused technology for a crude oil pipeline. The oil was displaced from the whole section and the section was then cleaned using a specially-developed biodegradable chemical agent. This enabled work on the pipeline to be undertaken with open flame, i.e. using standard oxy-acetylene cutters, and to carry out the follow-up welding work without any special environmental or fire protection. The application of this new technology enabled to the exchange of this significant number of pipes to be undertaken in a very short time, which traditional technologies (for example, plugging the line ore vacuating the crude oil) would not

have permitted. A relatively-low resulting cost was another advantage of this new technology.

15.05 Coffee

15.30 [18] Electric resistance welds: a grind repair review, by **Kelvin Fahy** and **André Goncalves**, Penspen Integrity, Newcastle upon Tyne, UK

Electric-resistance welded (ERW) pipe is used in both oil and gas pipelines. The term ERW refers to the method of producing the longitudinal seam weld which involves forcing the edges of the plate together under pressure while passing a powerful electric current through them, and the weld is achieved quickly and without the need for filler material. The ERW manufacturing process is often associated with defects in and around the seam weld, particularly in pre-1970s pipe. These issues are well-documented; however, there is limited guidance in national and international standards on how to deal with them. Ultrasonic crack-detection tools have been used to inspect a number of ERW pipelines, and numerous 'cracks' or 'crack-like' features have been reported in and around the seam weld area. The most likely cause of in-service cracks in ERW pipe is fatigue; however, the geometry and behaviour of the features reported was not consistent with fatigue crack growth. This paper describes the investigation to identify the origins of these ERW features, the review of repair guidance in industry standards, and the guidance on the use of grinding as a repair for the reported features.

16.10 [19] Development and qualification of welding procedures and inspection methodology for in-service welding, by **Joanna Nicholas**, TWI Ltd, Great Abington, UK

In-service welding is often applied for repair and modification, whether for pipelines or pipework/equipment. TWI has assisted many companies in determining the welding parameters that can be used safely, avoiding burn-through of the carrier pipe, and ensuring that fabrication hydrogen cracking does not occur. TWI has a long association with in-service welding procedure development, and also the application of inspection techniques for the geometries of concern.

This paper presents a case study in which TWI's expertise in developing safe in-service welding procedures and phased-array inspection methodology for welds were applied to an onshore pipeline in preparation for modification. The work was based upon the knowledge available in advance of the hot tap, and the welding procedure that was developed was qualified at TWI using a 24-in flow loop which allowed control and monitoring of the flowing liquid. The inspection methodology was developed on the qualification weld, although this was subsequently adapted by the welding contractor due to constraints not known at the time of development.

16.50 [20] A proposal for an emergency pipeline repair system and it application for the BTC pipeline, by **Okan Sandallioglu**, Botas International Ltd, Ceyhan, Turkey

This paper provides an overview of both temporary and permanent repair activities for mechanically-damaged pipes and a range of pipe-repair application scenarios for the Turkish section of the Baku-Tbilisi-Ceyhan (BTC) pipeline. Technologies include composite sleeves, epoxy coating, illegal hot-tap fitting removal, hot-tap and Stopple operation with a temporary by-pass, and reinforced full-encirclement sleeves. The operator has learned through past experience that the right decision and proper application of the repair method saves both time and costs. By closely watching what is available on the global pipeline repair application scene, and what new repair methods are available, Botas International has effectively focused on a number of realistic pipeline repair techniques which are now available for emergency applications.

17.30 End of conference